

The Divergence Parameter

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One of the most difficult questions in SNO data analyses is how can one know whether an event is accurately reconstructed or not. The answer to this question is important because, although fitters are normally able to reconstruct most of events accurately, the number of external background events such as PMT β - γ events are several magnitudes higher than number of genuine D_2O events so that there may still be a large contaminations to the heavy water region. A new data analysis technique[1] has been developed to cope with this problem.

An event normally consists of some good hits, which refers to so called “in time” hits, and some bad hits, which refers to any hits not caused by photons travelling in straight lines. MC studies found that for most of mis-reconstructed events, a single bad hit could have a very large effect on the fit results. Normally an individual hit has a fairly small effect on the reconstruction results because almost all of the events relevant to data analyses have more than 30 hits. However, the situation may be totally different for mis-reconstructed events because they are rare and special.

The divergence technique looks at how divergent the fitted vertices could be if a single hit is purged from the reconstruction. Figure 1 presents results of the technique on two Monte Carlo events. For the well reconstructed event(bottom plot), all fitted vertices are clustered together. The situation is completely different for the mis-reconstructed event (upper plot), where two fitted vertices lie far away from the main cluster. In fact, these two vertices corresponds to the cases when the bad hits happen to be excluded from the fitting, and in such cases the fitter reconstructs the event fairly close to its true origin. As expected, the fitted vertices for the mis-reconstructed event are much more divergent than the well reconstructed event. For

an event with N hits, the maximal distance between a fitted vertex with N-1 hits used in the reconstruction and the fitted vertex with all N hits used in the reconstruction is used to quantify convergence/divergence of the fitted results. This maximal distance is called the divergence parameter *dis*.

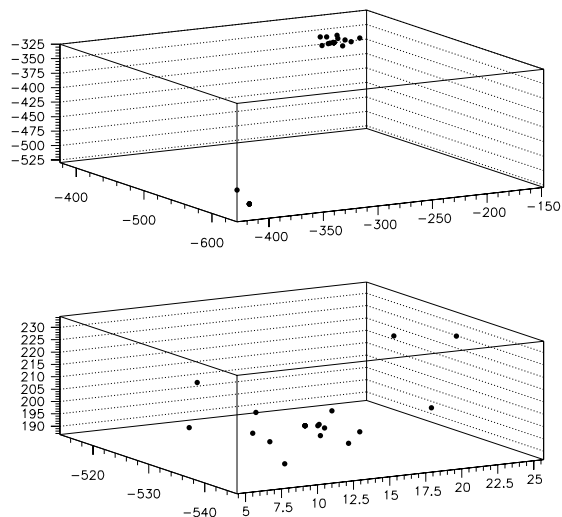


Figure 1: Results of the divergence technique for two events with same number of PMT hits. The top Figure shows the fit vertices for a PMT β - γ event mis-reconstructed into the D_2O region while the bottom Figure shows the fit vertices for a well reconstructed ^{208}Tl decay event in the D_2O . Note the difference in the scale of axes between the two Figures.

References

- [1] X.Chen; July 17, 2000; The Divergence Parameter, SNO-STR-2000-017.